



Test Report

Date : 2021-09-07
No. : HM21080043

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Applicant: AB CIRCLE LIMITED
Room 609, Cross Office Uchisaiwaicho, 1-18-6, Nishi-Shimbashi,
Minatoku, Tokyo, Japan 105-003

Manufacturer: Guangdong Haotian Technology Co., Ltd.
Dache Industrial Park, Yixian Road, Nanlang Town,
Zhongshan City, Guangdong Province, P.R. China

Description of Sample(s): Product: Bluetooth® Contact Smart Card Reader
Brand Name: AB Circle Limited
Model Number: CIM515A

Date Sample(s) Received: 2021-08-24

Date Tested: 2021-08-30 to 2021-09-03

Statement: The result included is only for the Bluetooth part of the product.
The test result in this report refers exclusively to the presented test model / sample.

The measurements and test results shown in this test report were made in accordance with the procedures and found in compliance with the limit given in Article 2 Paragraph 1 Item 19 of the Certification and MIC Notice No. 88 Appendix No. 43. The test equipment used to perform the test is calibrated and traceable to International system of units (SI) or other recognized National metrology institute.

Remark(s): 2.4GHz Bluetooth

Brian Chan



Dr. Chan Kwok Hung, Brian,
Authorized Signatory

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1.0 General Details

1.1 Test Laboratory

The Hong Kong Standards and Testing Centre Ltd.

1.1.1 Test Location

10 Dai Wang Street, Taipo Industrial Estate, New Territories, Hong Kong

1.2 Equipment Under Test [EUT] Description of Sample(s)

Product:	Bluetooth® Contact Smart Card Reader
Manufacturer:	Guangdong Haotian Technology Co., Ltd. Dache Industrial Park, Yixian Road, Nanlang Town, Zhongshan City, Guangdong Province, P.R. China
Brand Name:	AB Circle Limited
Model Number:	CIM515A
Hardware Version:	V1.0
Software Version:	V1.0
Rating:	USB 5.0 Vd.c 1 x 3.7V rechargeable battery (model no.: XJ303048)

1.2.1 Description of EUT Operation

The Equipment Under Test (EUT) is 2.4G BLE card reader, modulation by IC; and modulation type is GFSK. The EUT was set to test mode during test, the testing frequency was controlled by test software - nRFgo Studio used during tests.

1.3 Date of Order

2021-08-24

1.4 Submitted Sample(s):

2 Samples

1.5 Test Duration

2021-08-30 to 2021-09-03

1.6 Country of Origin

China

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1.7 Product Details

1.7.1 RF Module

Class of Unit:	Article 2 paragraph 1 item 19		
Frequency Range:	2402-2480MHz		
Channel Number:	0 to 39		
Modulation:	GFSK		
Duty Cycle:	Up to 100%		
ID Code:	C2:6B:43:C0:A9:49		
Operating mode:	Continuous		
Power Source:		Input voltage	RF module voltage
	Voltage (nom):	3.70Vd.c	3.3Vd.c
	Extreme high:	4.00Vd.c	
	Extreme low:	3.08 Vd.c	
Declared Output Power:	0.4 mW (-3.979 dBm)		

1.8 Table for Filed Antenna

Module 1

Ant.	Brand	Model Number	Antenna Type	Connector	Gain (dBi)
1	N/A	2.4G ANT	PCB Antenna	N/A	-1.61

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2.0 Technical Details

2.1 Table for Carrier Frequencies

Bluetooth EDR

Frequency Band	Channel No.	Frequency
2400-2483.5MHz	0	2402MHz
	1	2404MHz
	:	:
	18	2438MHz
	19	2440MHz
	20	2442MHz
	:	:
	38	2478MHz
	39	2480MHz

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2.2 Test Standards and Results Summary Tables

Applied Standard: MIC Public Notice 88, Annex 43				
ARIB STD-T66 Clause	Description of Test	Test Result		
		Pass	Fail	N/A
3.2 (4)	Frequency Tolerance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.2 (7)	Permissible Value for Occupied Bandwidth	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.2 (8) (9)	Spread Bandwidth and Process gain	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.2 (2) (3)	Antenna Power and Antenna Power Tolerance (Conducted)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.2 (6)	Transmitter Spurious Emission Intensity (Conducted)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.3 (1)	Receiver – Secondary Radiated Emissions (Conducted)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.4.1	Interference Prevention Function	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Note 1: MIC Ordinance Regulating Radio Equipment Section 3.17 of Article 49.20

Test Items	Uncertainty	Remark
Frequency Tolerance / 99% & 90% Bandwidth	$\pm 8.5 \times 10^{-8}$	Confidence levels of 95%
Antenna Power	$\pm 0.8\text{dB}$	Confidence levels of 95%
TX-RX Spurious Emissions	$\pm 0.5\text{dB}$	Confidence levels of 95%
Transmission Antenna Gain	$\pm 2.6\text{dB}$	Confidence levels of 95%
Temperature	$\pm 0.7^{\circ}\text{C}$	Confidence levels of 95%
Humidity	$\pm 3.2\%$	Confidence levels of 95%
DC/AC Power Source	$\pm 1.4\%$	Confidence levels of 95%

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2.3 Table for Test Modes

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases.

The following table is a list of the test modes shown in this test report.

Test Items	Mode	Data Rate	Channel
Frequency Tolerance	Unmodulated	-	0/19/38
Permissible Value for Occupied Bandwidth	GFSK	1Mbps	0/19/38
Spread Bandwidth and Process gain	GFSK	1Mbps	0/19/38
Transmitter Spurious Emission Intensity (Conducted)	GFSK	1Mbps	0/19/38
Antenna Power and Antenna Power Tolerance (Conducted)	GFSK	1Mbps	0/19/38
Receiver - Secondary Radiated Emissions (Conducted)	GFSK	1Mbps	0/19/38
Transmission Antenna Gain	-	-	-
Transmission Radiation Angle Width	-	-	-
Interference Prevention Function	GFSK	1Mbps	0/19/38
Dwell Time	-	-	-

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3.0 Test Results

3.1 Frequency Tolerance

3.1.1 Limit:

Item	Limits
Frequency Tolerance	≤ 50 ppm

3.1.2 Measuring Instruments and Setting

Please refer to section 4 of equipment list in this report. The following table is the setting of the spectrum analyzer.

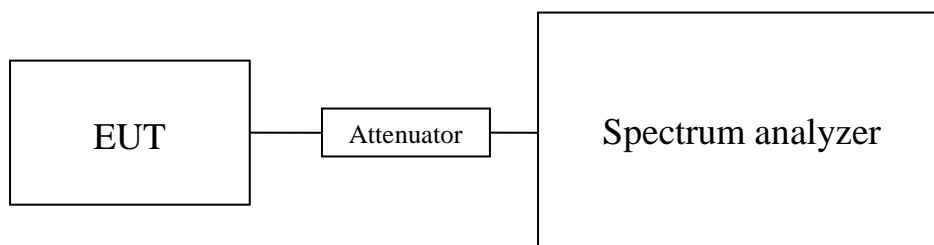
Spectrum Parameter	Setting
Span Frequency	Enough to cover the complete power envelope
RBW	10kHz
VBW	3 times of RBW
Sweep time	Auto
Sweep mode	Continuous sweep
Detector Mode	Positive Peak
Indication mode	Max hold

3.1.3 Test Procedures

The measuring method was according to MIC Public Notice 88, Annex 43

- Find the peak frequency and take calculate by the formula: (Measurement Value-declaration frequency)/ declaration frequency)

3.1.4 Test Setup Layout



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3.1.5 Test Deviation

There is no deviation with the original standard.

3.1.6 EUT Operation during Test

The EUT was placed on the test table and programmed in un-modulation function.

3.1.7 Results of Frequency Tolerance

Ambient Temperature: 20°C

Relative Humidity: 49%

Voltage Fluctuation Test

	Low Voltage (90% of Normal Voltage)	Normal Voltage	High Voltage (110% of Normal Voltage)
AC/DC Adaptor Input Voltage (V.a.c.)	--	--	--
Module Input Voltage (V.d.c.)	3.28	3.31	3.33
Module Rated Voltage (V.d.c.)	3.3		
Voltage Variation (%)	-0.91	--	0.6

Note:

Voltage Variation (%) = (Output High or Low Voltage – Output Normal Voltage) / Output Normal Voltage x 100%. During the input supply voltage to the EUT from the external power source is varied by $\pm 10\%$, if output voltage has been confirmed that the fluctuation of power supply to the RF circuit of the EUT (excluding power source) is equal to or less the $\pm 1\%$. Exempt extremely high and low supply voltage condition tests, EUT only operated in normal voltage to test all regulations.

Modulation	Channel Number	Channel Frequency (MHz)	Reading (MHz)	Deviation (kHz)	Tolerance (ppm)	Limit (ppm)	Verdict
Unmodulated carrier	0	2402.00	2402.004	4.0	1.67	50.0	Pass
	19	2440.00	2440.003	3.0	1.23	50.0	Pass
	39	2480.00	2480.004	4.0	1.61	50.0	Pass

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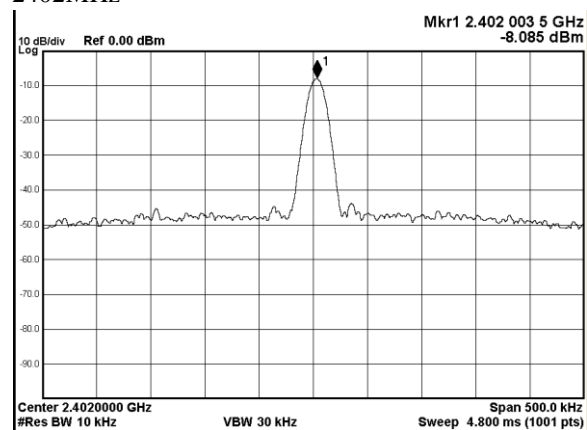


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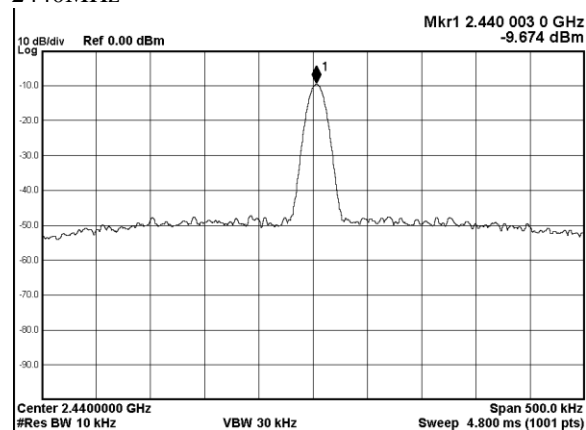
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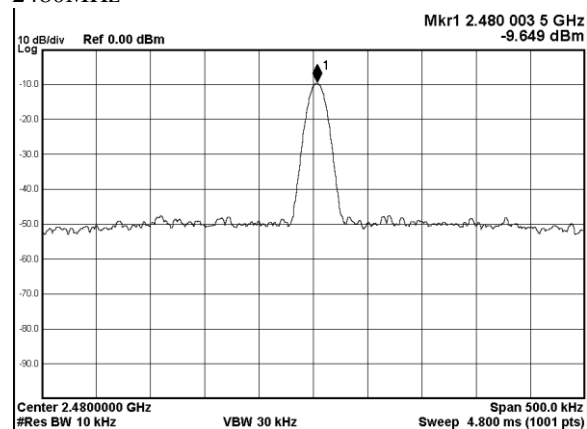
2402MHz



2440MHz



2480MHz



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3.2 Permissible Value for Occupied Bandwidth

3.2.1 Limit:

Item	Limits
Occupied Bandwidth	FH, FH+DS, FH+OFDM: $\leq 83.5\text{MHz}$ others: $\leq 26\text{MHz}$ OFDM: $\leq 38\text{MHz}$

3.2.2 Measuring Instruments and Setting

Please refer to section 4 of equipment list in this report. The following table is the setting of the spectrum analyzer.

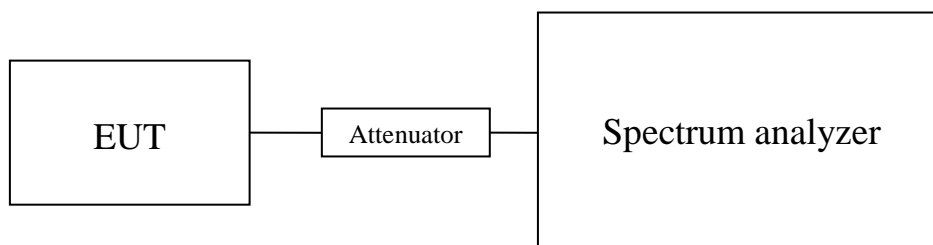
Spectrum Parameter	Setting
Span Frequency	Enough to cover the complete power envelope
RBW	30 kHz
VBW	3 times of RBW
Sweep time	Auto
Sweep mode	Continuous sweep
Detector Mode	Positive Peak
Indication mode	Max hold

3.2.3 Test Procedures

The measuring method was according to MIC Public Notice 88, Annex 43

- The occupied bandwidth was determined from the 99% power bandwidth by determining the highest and lowest frequencies at which 99% of the power was captured. The calculation was done by either the spectrum analyzer directly or via the software used to capture the plot.

3.2.4 Test Setup Layout



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3.2.5 Test Deviation

There is no deviation with the original standard.

3.2.6 EUT Operation during Test

The EUT was programmed to be in normal BLE mode.

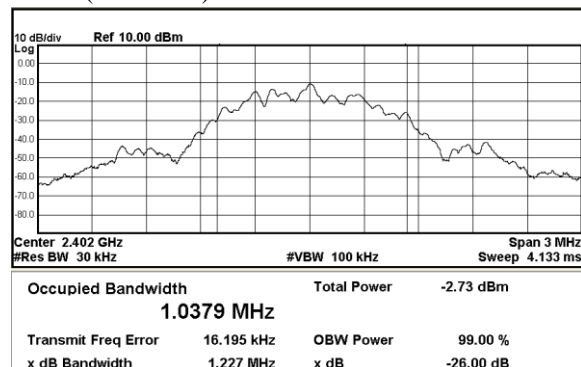
3.2.7 Results of Occupied Bandwidth (99% channel power bandwidth)

Ambient Temperature: 20°C

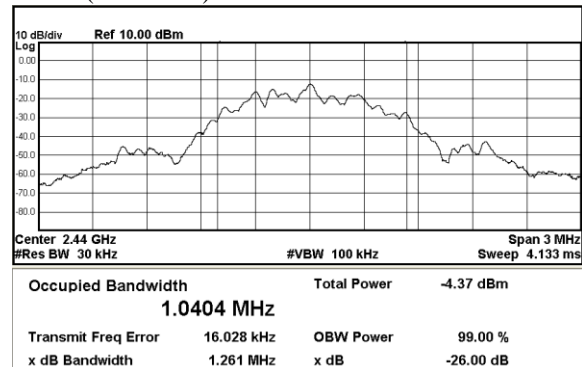
Relative Humidity: 49%

Modulation	Occupied Bandwidth (MHz)	Limit (MHz)	Verdict
GFSK	1.0416	≤ 26.0	Pass

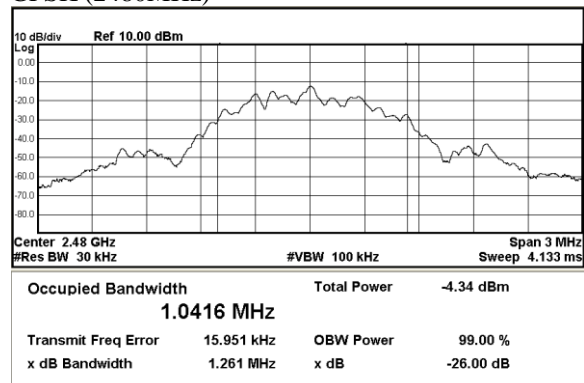
GFSK (2402MHz)



GFSK (2440MHz)



GFSK (2480MHz)



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3.3 Spread Bandwidth and Process gain

3.3.1 Limit:

Item	Limits
Spread Bandwidth	DS, FH, FH+DS, FH+OFDM: $\geq 500\text{kHz}$
Process gain	≥ 5

3.3.2 Measuring Instruments and Setting

Please refer to section 4 of equipment list in this report. The following table is the setting of the spectrum analyzer.

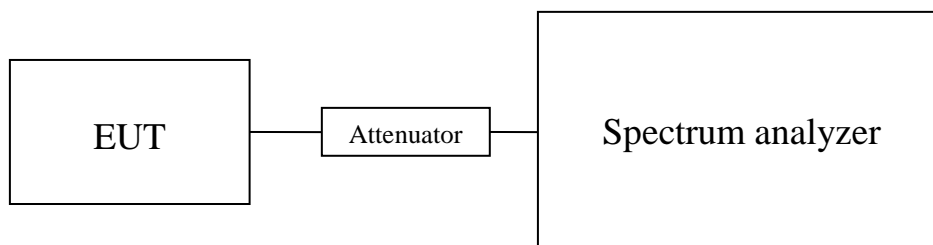
Spectrum Parameter	Setting
Span Frequency	Enough to cover the complete power envelope
RBW	30 kHz
VBW	3 times of RBW
Sweep time	Auto
Sweep mode	Continuous sweep
Detector Mode	Positive Peak
Indication mode	Max hold

3.3.3 Test Procedures

The measuring method was according to MIC Public Notice 88, Annex 43

- The occupied bandwidth was determined from the 90% power bandwidth by determining the highest and lowest frequencies at which 90% of the power was captured. The calculation was done by either the analyzer directly or via the software used to capture the plot.

3.3.4 Test Setup Layout



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3.3.5 Test Deviation

There is no deviation with the original standard.

3.3.6 EUT Operation during Test

The EUT was programmed to be in normal BLE mode.

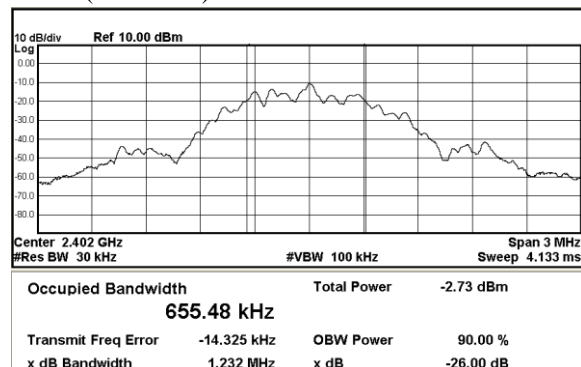
3.3.7 Results of Spread Bandwidth and Process gain

Ambient Temperature: 20°C

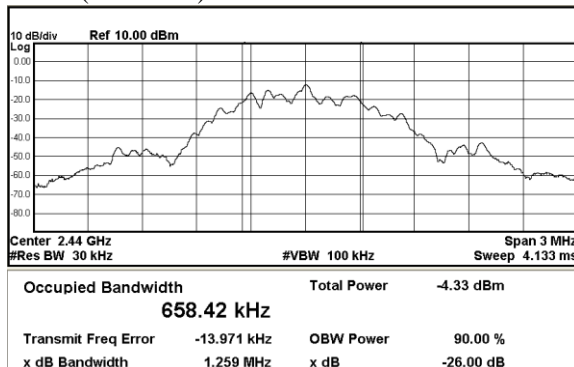
Relative Humidity: 49%

Modulation	Spread Bandwidth (MHz)	Limit (kHz)	Verdict
GFSK	0.659	≥ 500	Pass

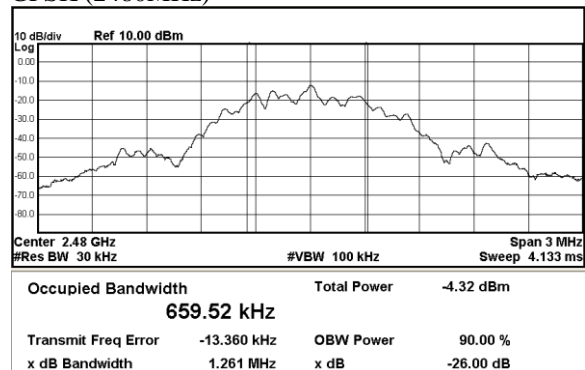
GFSK (2402MHz)



GFSK (2440MHz)



GFSK (2480MHz)



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3.4 Antenna Power and Antenna Power Tolerance (Conducted)

3.4.1 Limit

Item	Limits
Antenna Power Density	≤ 3 mW/MHz (FH from 2427 – 2470.75 MHz) ≤ 10 mW/MHz (OFDM, DS from 2400 – 2483.5 MHz) ≤ 10 mW (Other from 2400 – 2483.5 MHz)
Antenna Power Error	+20%, -80% (Base on manufacture declare antenna power density)

3.4.2 Measurement Instruments and Setting

Please refer to section 4 of equipment list in this report. The following table is the setting of the spectrum analyzer.

Spectrum Parameter	Setting
Span Frequency	Enough to cover the complete power envelope
RBW	1MHz
VBW	3 times of RBW
Sweep time	Auto
Sweep mode	Continuous sweep
Detector Mode	Positive Peak
Indication mode	Max hold

3.4.3 Test Procedures

The measuring method was according to MIC Notice No.88 Appendix No.43

- EUT have transmitted continuous maximum power.
- Measure the equivalent noise bandwidth at the spectrum analyzer for resolution bandwidth of 1 MHz, then read the value correcting the resolution bandwidth on the 1 MHz equivalent bandwidth. In case of a spreading bandwidth lower than 1 MHz, however, perform the correction only for a higher value than “Spreading bandwidth (MHz) / Equivalent noise bandwidth (MHz)”.
- Antenna Power Error is definition that actual measure antenna power tolerance between +20% to 80% power range that base on manufacturer declare the conducted power density.

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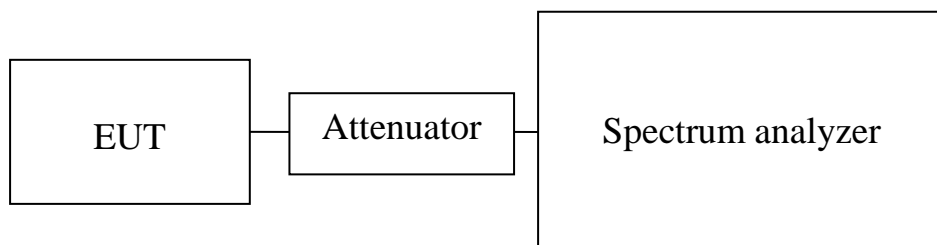


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3.4.4 Test Setup Layout



3.4.5 Test Deviation

There is no deviation with the original standard.

3.4.6 EUT Operation during Test

The EUT was programmed to be in normal BLE mode.

3.4.7 Results of Antenna Power Error

Ambient Temperature: 20°C

Relative Humidity: 49%

Cable loss

30MHz – 1GHz	0.8 dB
1GHz – 2.387GHz	0.9 dB
2.387GHz – 2.4GHz	0.9 dB
2.4835GHz – 2.4965GHz	0.9 dB
Above 2.4965GHz	2.1 dB

Frequency (MHz)	Modulation	Total Power (dBm)	Total Power (mW)	Limit (mW)	Verdict
2402	GFSK	-4.584	0.348	≤ 10.0	Pass
2440		-4.524	0.353	≤ 10.0	Pass
2480		-4.794	0.332	≤ 10.0	Pass

Frequency (MHz)	Modulation	Antenna Power Error (%)	Limit	Verdict
2402	GFSK	-24.1	+20% to -80%	Pass
2440		-23.4	+20% to -80%	Pass
2480		-28.1	+20% to -80%	Pass

Total Power = Measurement reading + cable loss

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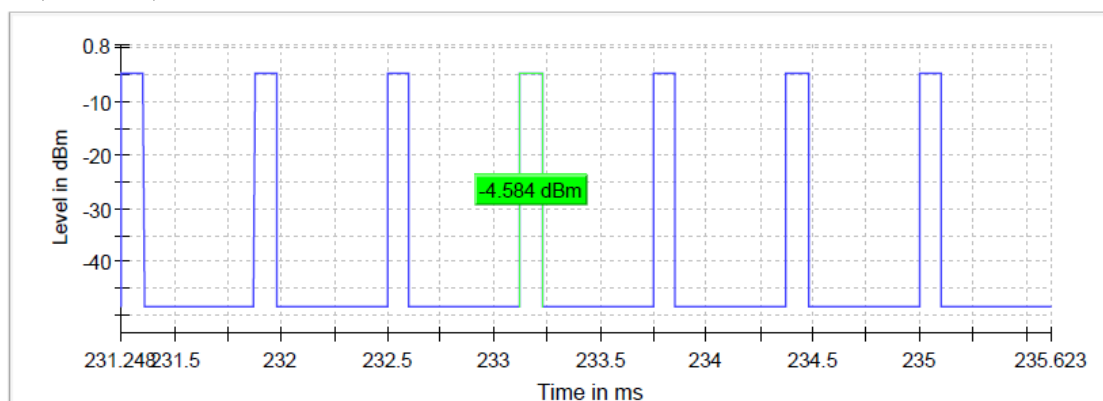
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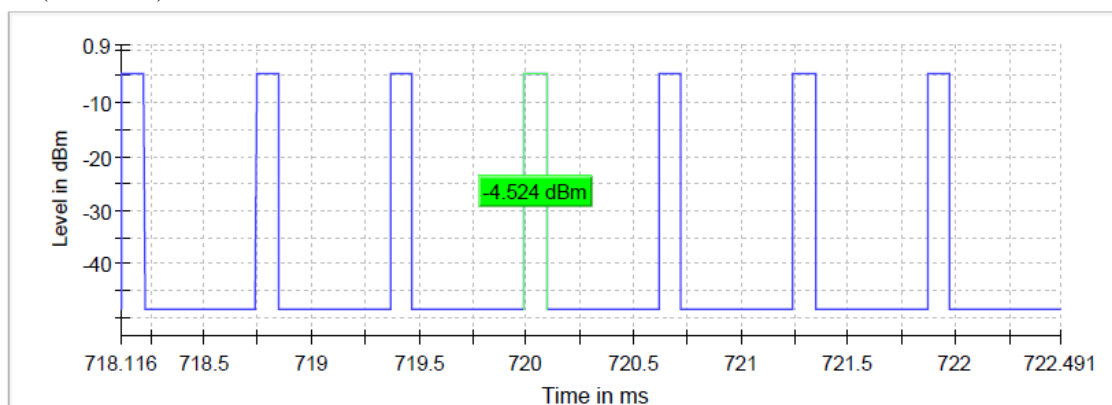
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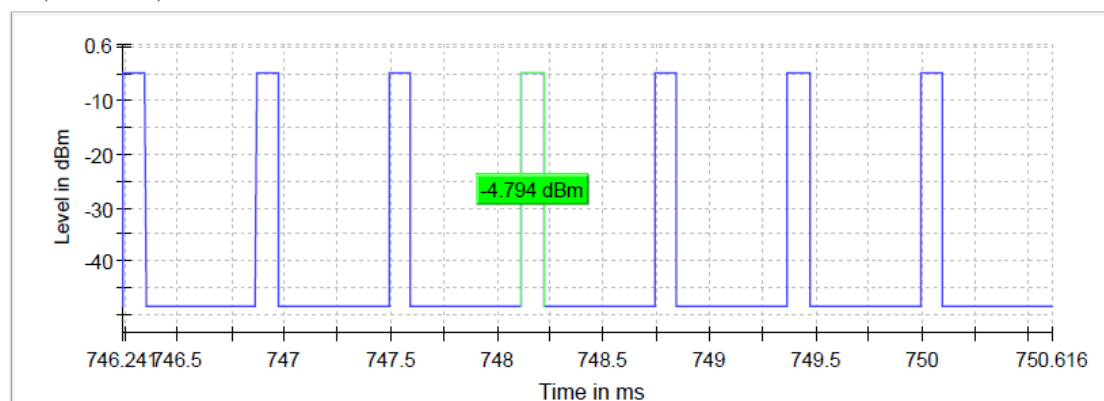
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GFSK (2480MHz)



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3.5 Transmitter Spurious Emission Intensity (Conducted)

3.5.1 Limit

Item	Limits
Transmitter Spurious Emission Intensity	$\leq 0.25\mu\text{W}$ (30MHz – 1000MHz)
	$\leq 2.5\mu\text{W}$ ($f > 1000\text{MHz}$ and $2387\text{MHz} < f$; $2496.5\text{MHz} < f$)
	$\leq 25\mu\text{W}$ ($2387\text{MHz} \leq f < 2400\text{MHz}$) and ($2483.5\text{MHz} < f \leq 2496.5\text{MHz}$)

3.5.2 Measurement Instruments and Setting

Please refer to section 4 of equipment list in this report. The following table is the setting of the spectrum analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
RBW	100kHz (Frequency below 1000MHz) 1MHz (Frequency above 1000MHz)
VBW	3 times of RBW
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

3.5.3 Test Procedures

The measuring method was according to MIC Notice No.88 Appendix No.43

- EUT have transmitted the maximum modulation signal and fixed channelize.
- Find out and record the emission level in the required frequency range.

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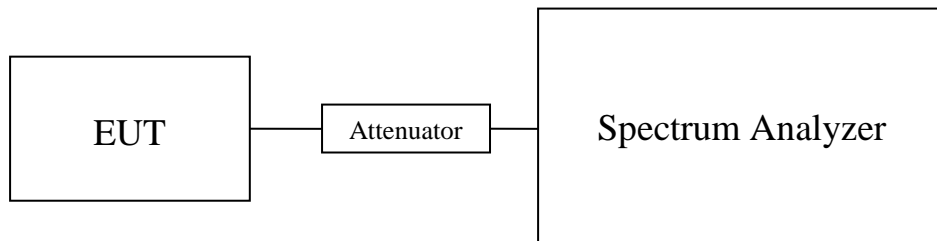
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3.5.4 Test Setup Layout



3.5.5 Test Deviation

There is no deviation with the original standard.

3.5.6 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

3.5.7 Results of Transmitter Spurious Emission Intensity (Conducted)

Ambient Temperature: 21°C

Relative Humidity: 49%

Cable loss

30MHz – 1GHz	0.8 dB
1GHz – 2.387GHz	0.9 dB
2.387GHz – 2.4GHz	0.9 dB
2.4835GHz – 2.4965GHz	0.9 dB
Above 2.4965GHz	2.1 dB

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Test Frequency	2402 MHz				Limit
Result	dBm/100kHz	μW/100kHz	dBm/MHz	μW/MHz	
30MHz – 1GHz	-78.881	0.00001	--	--	0.25μW/100kHz (-36dBm)
1GHz – 2.387GHz	--	--	-55.772	0.00265	2.5μW/MHz (-26dBm)
2.387GHz – 2.4GHz	--	--	-33.741	0.42257	25μW/MHz (-16dBm)
2.4835GHz – 2.4965GHz	--	--	-63.611	0.00044	
Above 2.4965GHz	--	--	-61.224	0.00075	2.5μW/MHz (-26dBm)

Test Frequency	2440 MHz				Limit
Result	dBm/100kHz	μW/100kHz	dBm/MHz	μW/MHz	
30MHz – 1GHz	-79.029	0.00001	--	--	0.25μW/100kHz (-36dBm)
1GHz – 2.387GHz	--	--	-59.303	0.00117	2.5μW/MHz (-26dBm)
2.387GHz – 2.4GHz	--	--	-62.659	0.00054	25μW/MHz (-16dBm)
2.4835GHz – 2.4965GHz	--	--	-64.054	0.00039	
Above 2.4965GHz	--	--	-63.514	0.00045	2.5μW/MHz (-26dBm)

Test Frequency	2480 MHz				Limit
Result	dBm/100kHz	μW/100kHz	dBm/MHz	μW/MHz	
30MHz – 1GHz	-79.682	0.00001	--	--	0.25μW/100kHz (-36dBm)
1GHz – 2.387GHz	--	--	-59.413	0.00114	2.5μW/MHz (-26dBm)
2.387GHz – 2.4GHz	--	--	-62.373	0.00058	25μW/MHz (-16dBm)
2.4835GHz – 2.4965GHz	--	--	-41.206	0.07575	
Above 2.4965GHz	--	--	-56.032	0.00249	2.5μW/MHz (-26dBm)

Emission value = Measurement reading + cable loss

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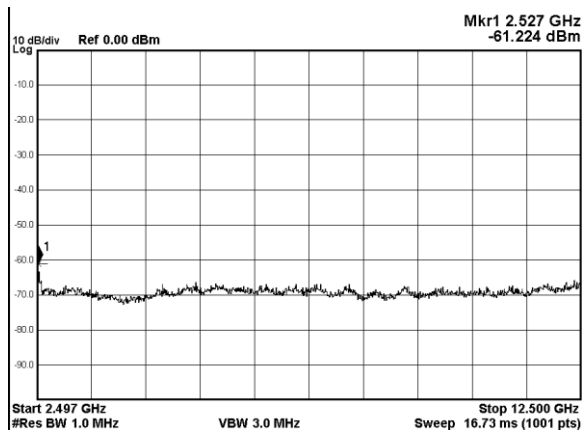
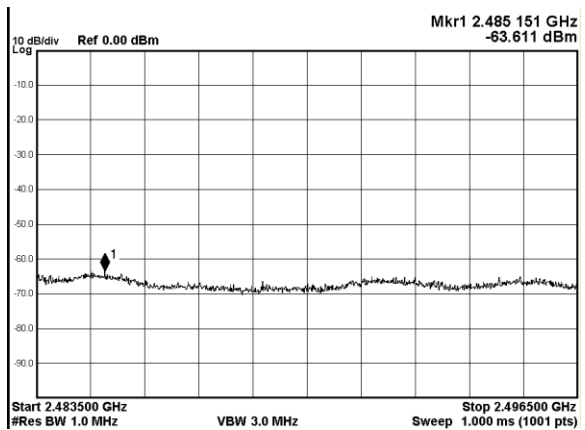
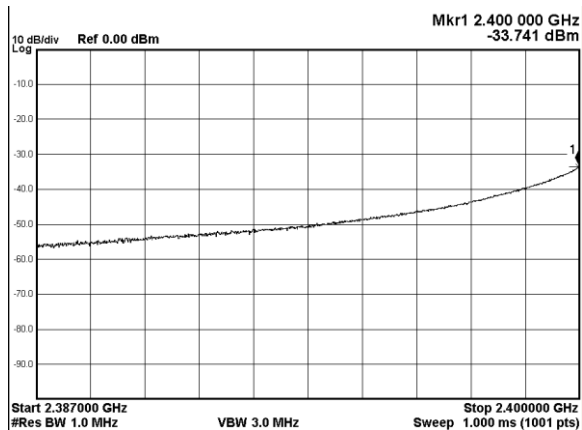
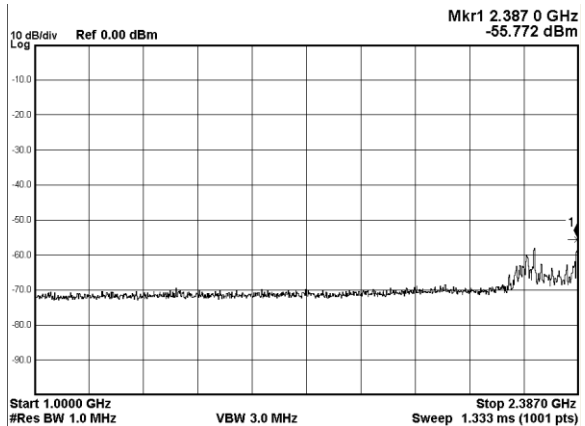
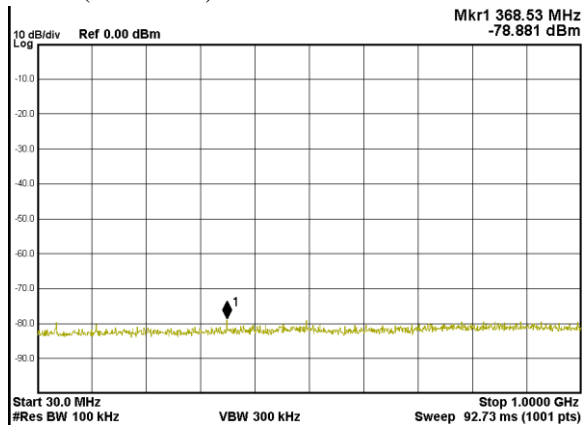


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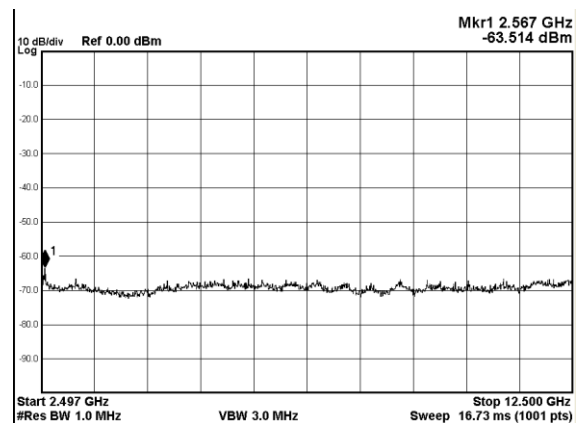
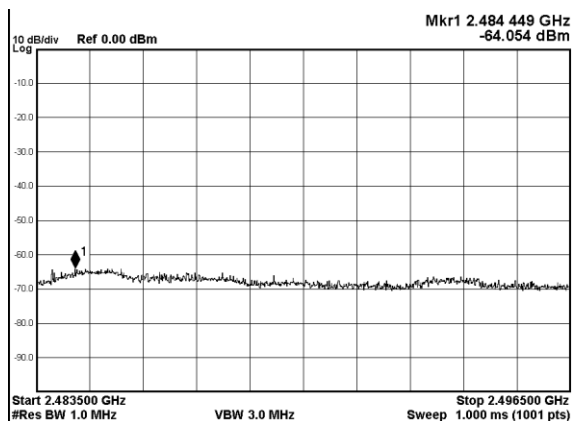
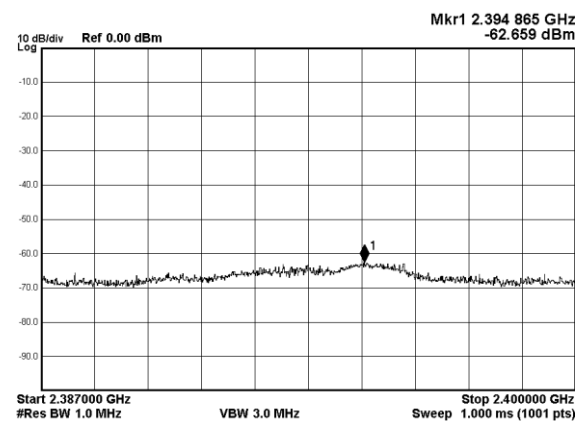
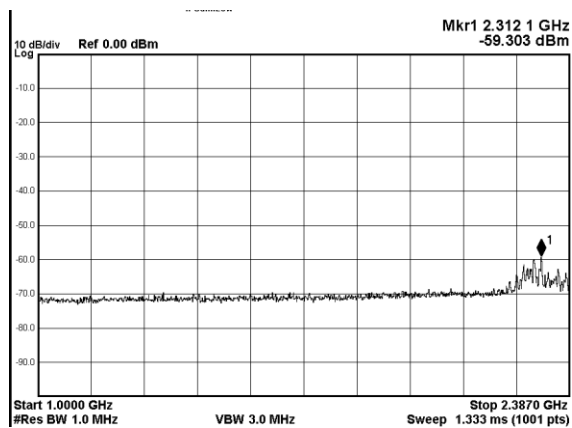
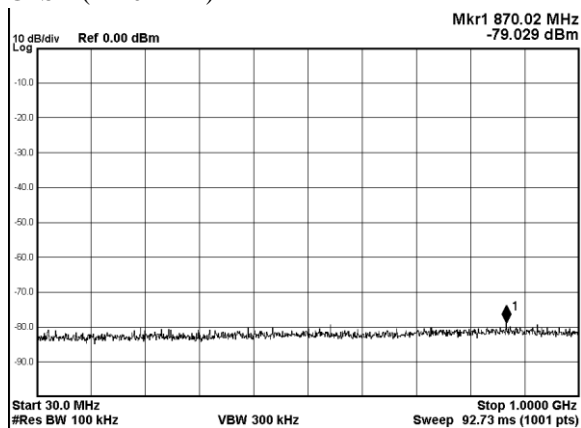


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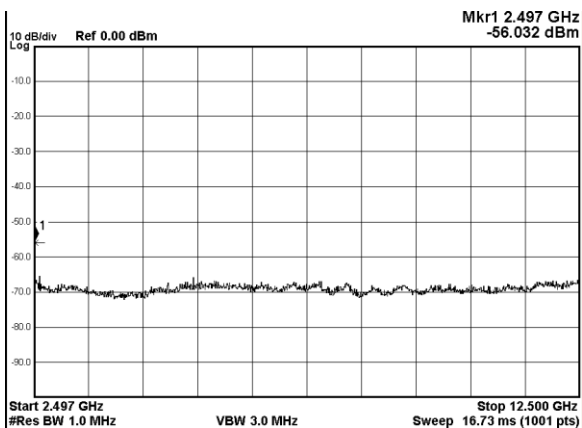
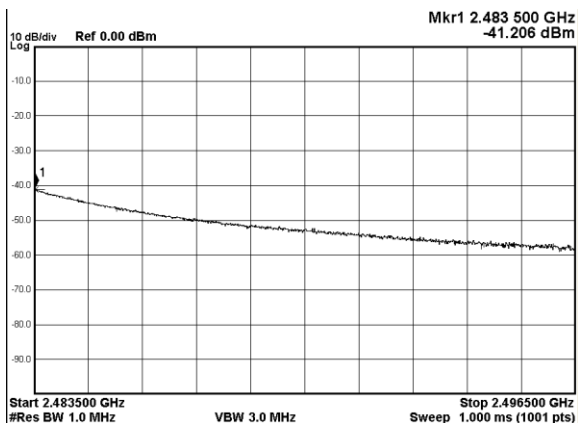
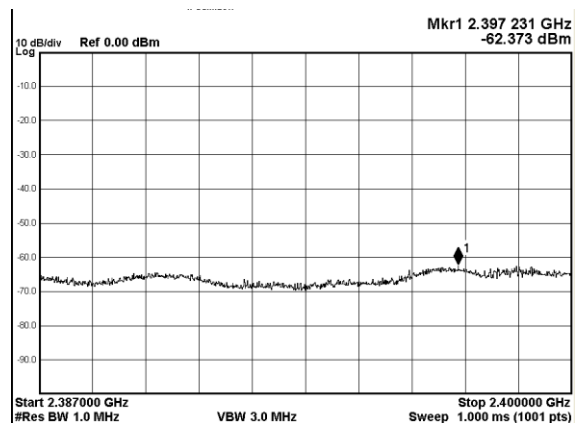
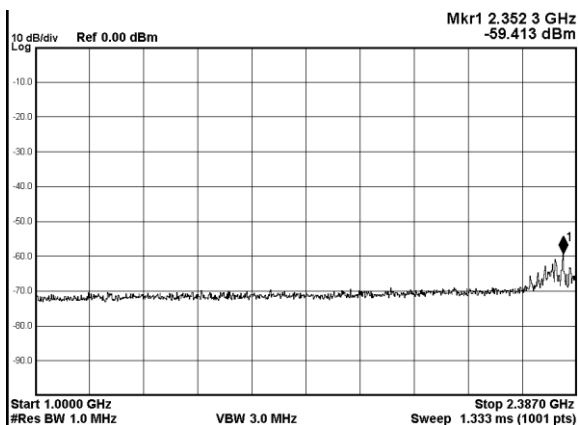
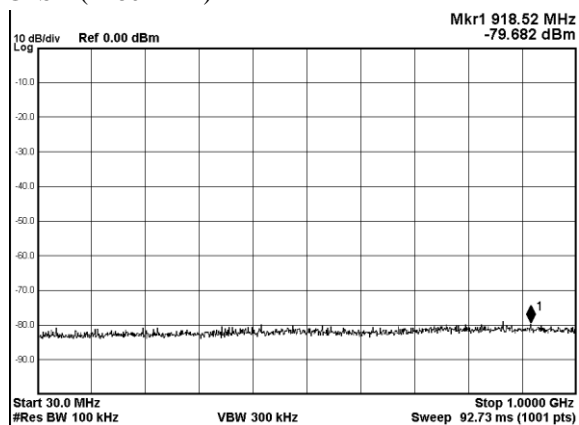


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3.6 Receiver Spurious Emissions (Conducted)

3.6.1 Limit

Item	Limits
Rx Spurious Emission	$\leq 4\text{nW}$ ($f < 1\text{GHz}$)
	$\leq 20\text{nW}$ ($1\text{GHz} \leq f$)

3.6.2 Measurement Instruments and Setting

Please refer to section 4 of equipment list in this report. The following table is the setting of the spectrum analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
RBW	100kHz (Frequency below 1000MHz) 1MHz (Frequency above 1000MHz)
VBW	3 times of RBW
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

3.6.3 Test Procedures

The measuring method was according to MIC Notice No.88 Appendix No.43

- EUT have transmitted the maximum modulation signal and fixed channelize.
- Find out and record the emission level in the required frequency range.

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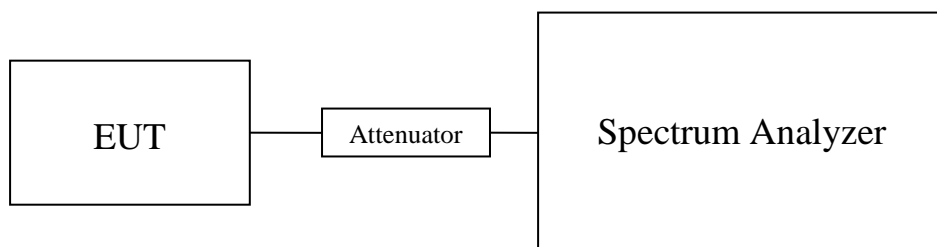
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3.6.4 Test Setup Layout



3.6.5 Test Deviation

There is no deviation with the original standard.

3.6.6 EUT Operation during Test

The EUT was programmed to be in continuously receiving mode.

3.6.7 Results of Limitation of Collateral Emission of Receiver

Ambient Temperature: 21°C

Relative Humidity: 49%

Cable loss

30MHz – 1GHz	0.8 dB
1GHz – 2.387GHz	0.9 dB
2.387GHz – 2.4GHz	0.9 dB
2.4835GHz – 2.4965GHz	0.9 dB
Above 2.4965GHz	2.1 dB

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Test Frequency	2402 MHz				Limit
Result	dBm/100kHz	nW/100kHz	dBm/MHz	nW/MHz	
30MHz – 1GHz	-77.333	0.01848	--	--	4nW/100kHz (-54dBm)
1GHz – 12.750GHz	--	--	-65.719	0.26798	20nW/MHz (-47dBm)

Test Frequency	2440 MHz				Limit
Result	dBm/100kHz	nW/100kHz	dBm/MHz	nW/MHz	
30MHz – 1GHz	-76.940	0.02023	--	--	4nW/100kHz (-54dBm)
1GHz – 12.750GHz	--	--	-65.813	0.26224	20nW/MHz (-47dBm)

Test Frequency	2480 MHz				Limit
Result	dBm/100kHz	nW/100kHz	dBm/MHz	nW/MHz	
30MHz – 1GHz	-76.269	0.02361	--	--	4nW/100kHz (-54dBm)
1GHz – 12.750GHz	--	--	-66.339	0.23233	20nW/MHz (-47dBm)

Emission value = Measurement reading + cable loss

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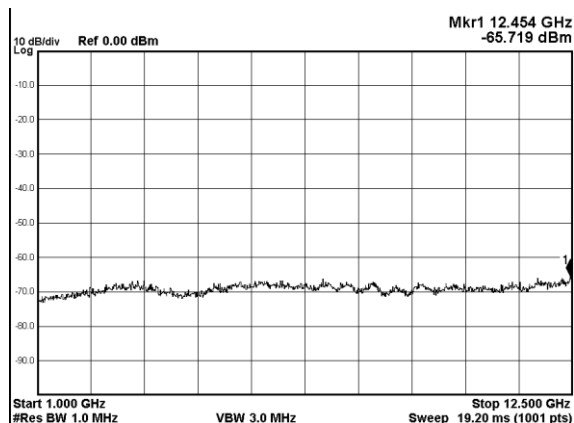
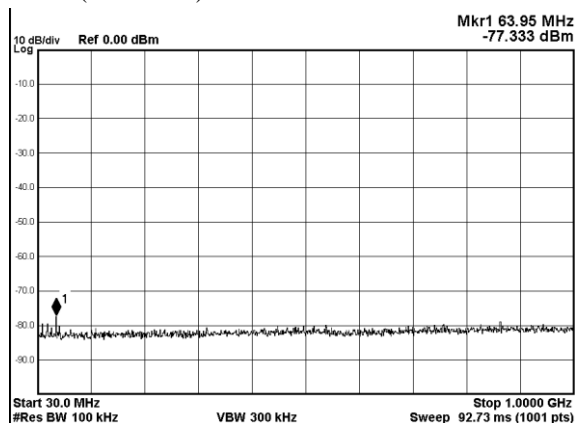


Test Report

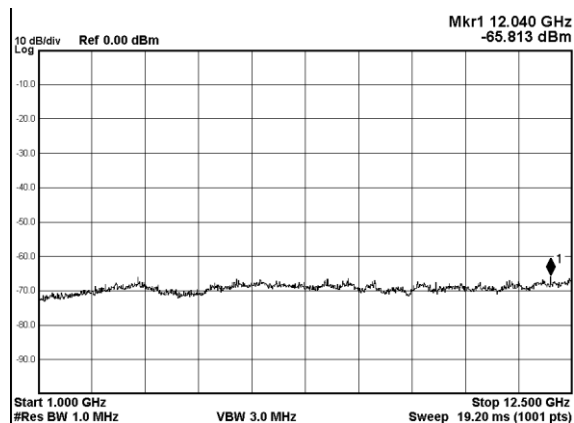
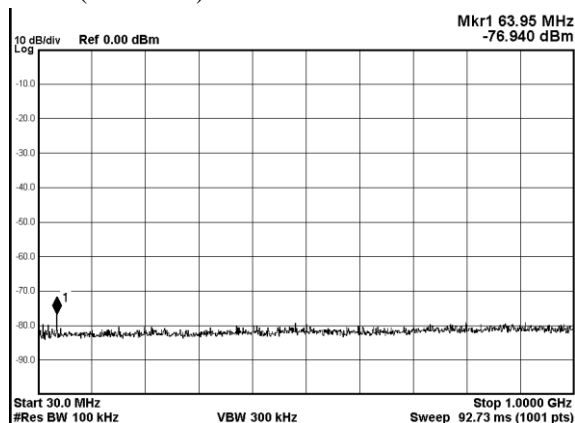
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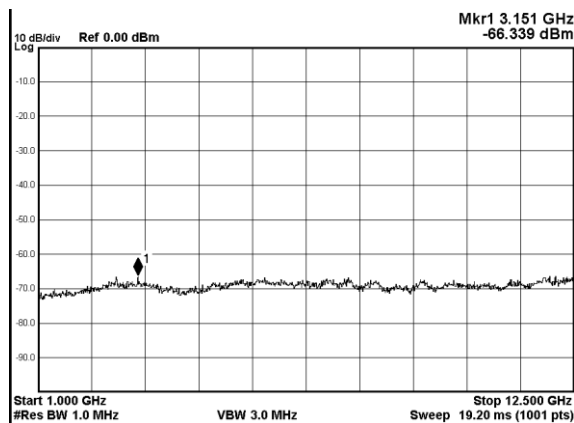
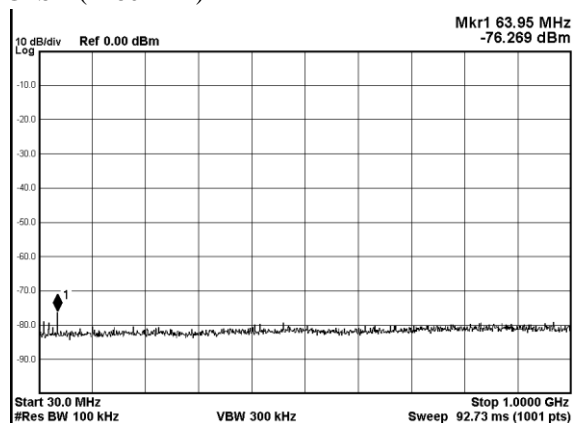
GFSK (2402MHz)



GFSK (2440MHz)



GFSK (2480MHz)



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3.7 Interference Prevention Function

3.7.1 Limit:

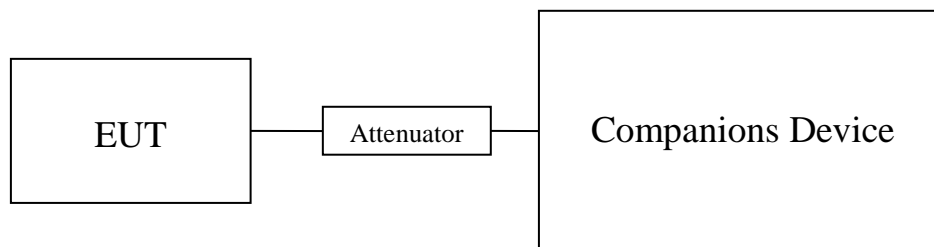
Item	Limits
ID code	≥ 48 bits

3.7.2 Test Procedures

The measuring method was according to MIC Notice No.88 Appendix No.43

- Use the companions device to check the transmitted identification code from the EUT

3.7.3 Test Setup Layout



3.7.4 Test Results

Interference Prevention Function	ID code: C2:6B:43:C0:A9:49	Limit ≥ 48 bit
----------------------------------	----------------------------	---------------------



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APPENDIX A

List of Measurement Equipment

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM363	SIGNAL ANALYZER	ROHDE & SCHWARZ	FSV40	101231	2019/10/08	2021/10/08
EM364	8-PORT MODULES FOR SWITCH UNITS	ROHDE & SCHWARZ	OSP-B157W8	101002	N/A	N/A
EM293	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	N9020A	MY50510152	2020/11/25	2021/11/25
N/A	RF TEST SOFTWARE	ROHDE & SCHWARZ	EMC32	V10.40.0.10	N/A	N/A
EM527	RF CABLE	SUHNER	SUCOFLEX 102	24514	2019/04/19	2022/04/19

Remark:

N/A Not Applicable

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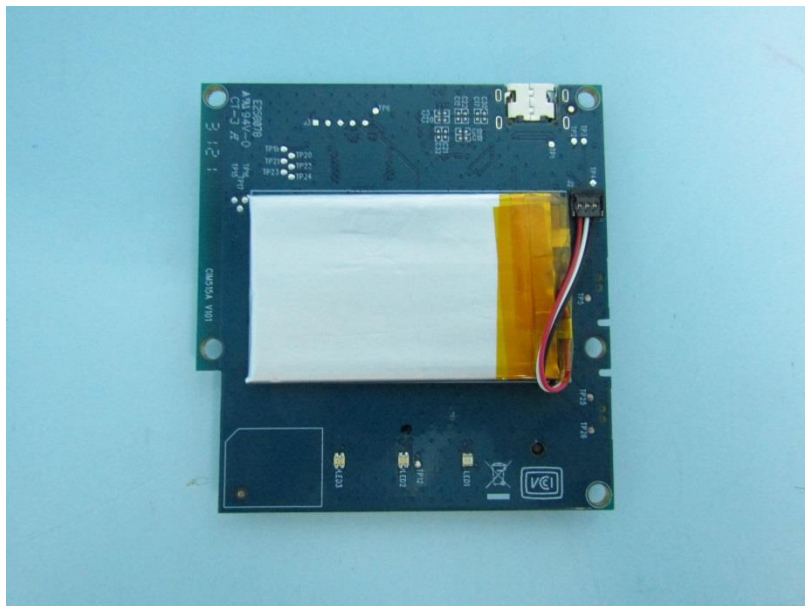
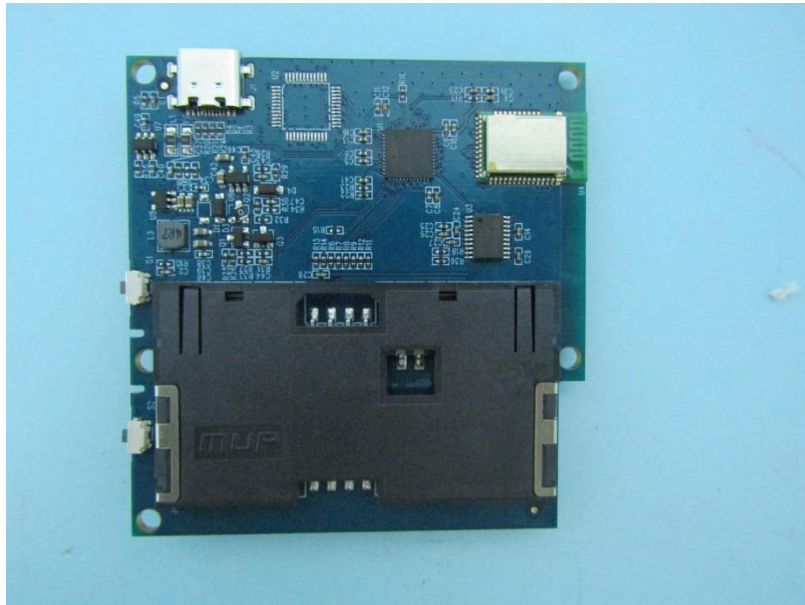
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Photographs of EUT



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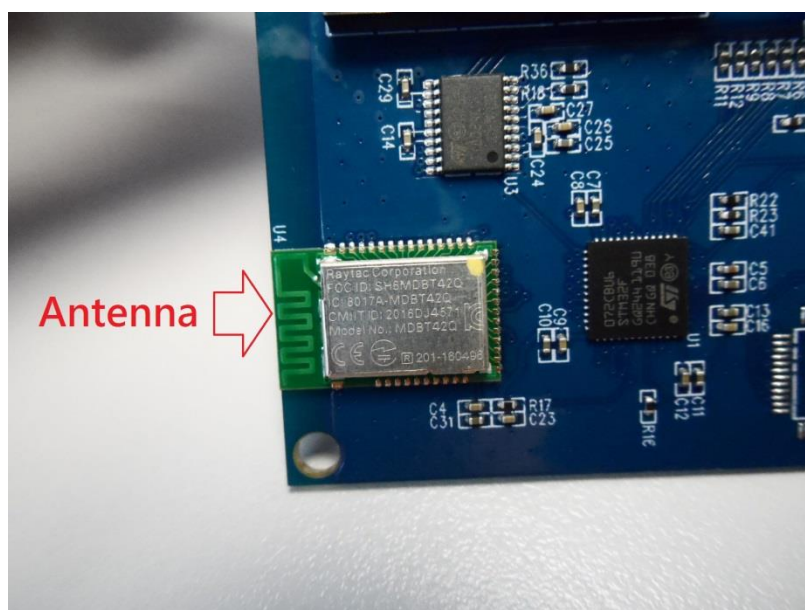
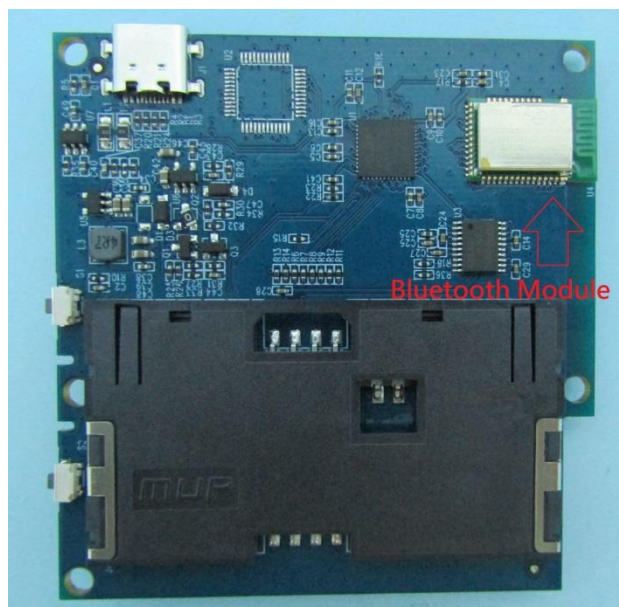
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Photographs of EUT



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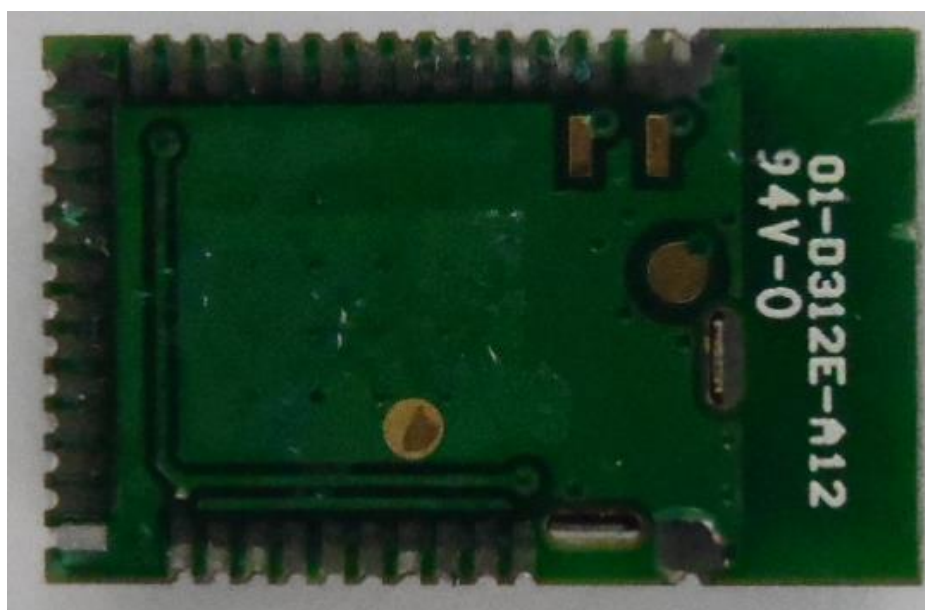
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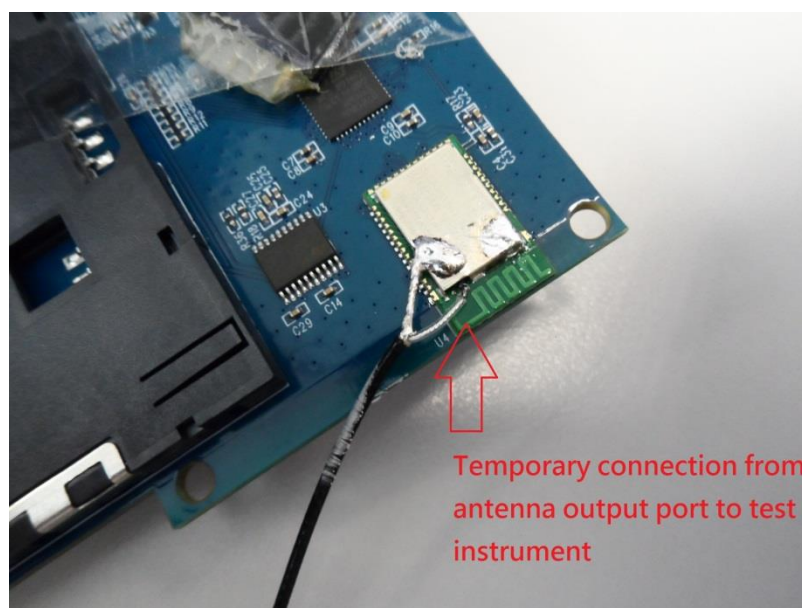
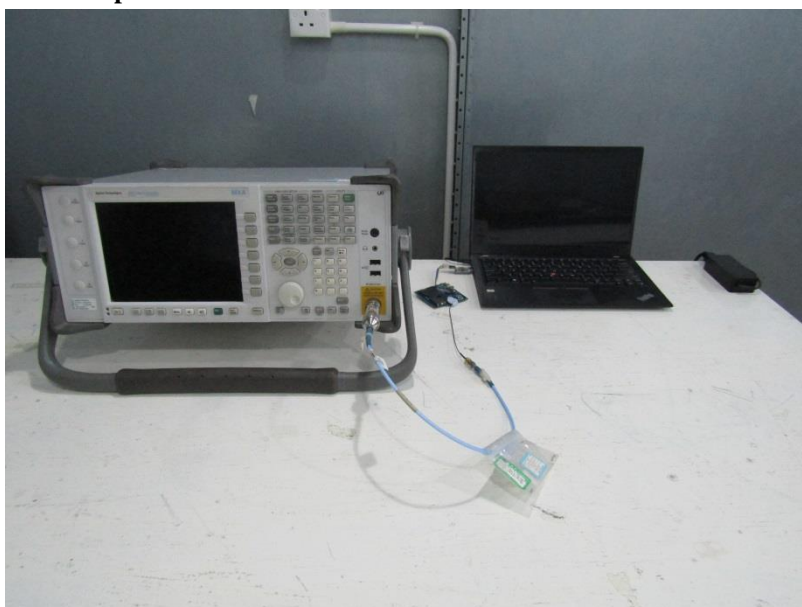
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Appendix C

Photograph(s) of Test Setup



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